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Ian [GB/GB]; 12 Caledonian Place, Aberdeen, AB11 6TT
(GB).

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(74) Agent: **KENNEDYS Patent Agency Limited**; Floor 5,
Queens House, 29 St Vincent Place, Glasgow G1 2DT
(GB).

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(71) Applicant (for all designated States except US): **BOREAS
CONSULTANTS LIMITED** [GB/GB]; 3 Bon Accord
Square, Aberdeen AB11 6DJ (GB).

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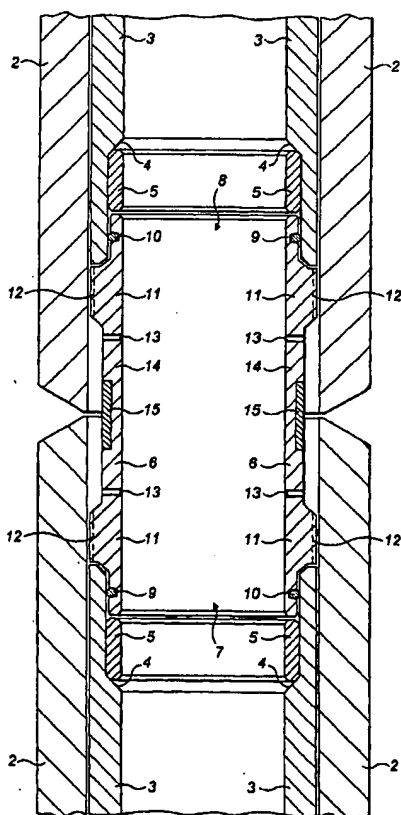
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(72) Inventor; and

(75) Inventor/Applicant (for US only): **MCINTYRE, Stuart,**

[Continued on next page]

(54) Title: PIPE LINER CONNECTOR



(57) Abstract: A pipe liner connector (1) suitable for connecting pipe sections (2) that comprise a liner (3) is described. The pipe liner connector (1) comprise vents (13, 18) and/or venting grooves (12) which act to balance the pressure between the micro-annulus, formed between the liner (3) and the pipe sections (2), and the pipe bore formed when the pipe sections (2) are connected together. The inclusion of these features helps prevent the collapse or the uncontrolled distortion of the pipe liner connector (1) during pressure cycles in operating pipelines.

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DT01 Rec'd PCT/PTC 24 JAN 20051 Pipe Liner Connector

2

3 The present invention relates to apparatus for the
4 connection of pipe liners. In particular, the apparatus
5 provides a connector suitable for use with a liner
6 employed in a vented oil, gas or other service pipeline.

7

8 It is known to those skilled in the art that pipelines
9 and other fluid transport systems (such as tubing used
10 down-hole in oil wells and process pipework in refineries
11 and the like) can have their lifetimes significantly
12 increased by employing a liner. The liner is
13 incorporated within the pipeline so as to reduce the
14 detrimental effects of corrosion or erosion by isolating
15 the bulk fluid from the pipe wall, however they are not
16 intended to be completely impermeable to gases.

17

18 The primary restriction on the use of such liners is
19 liner collapse due to pressure build up of gases in the
20 micro-annulus between the liner and the parent pipe. If
21 the differential pressure between the micro-annulus and
22 the pipe bore become sufficient, the liner may collapse
23 and suffer damage.

1 In PCT Application WO 02/33298 the authors themselves
2 teach of a vented liner that permits controlled
3 communication between the micro-annulus and the bore of
4 the pipe so as to permit pressure balancing and
5 consequent limitation on the pressure differential and
6 the tendency for collapse. However, with any such lined
7 pipe, specific consideration must be given to the
8 physical engineering and construction processes employed
9 to form complete lined fluid transport or pipework
10 system, and this gives rise to a number of ways in which
11 a liner may be inserted.

12

13 In some cases it is desirable to pass a length of liner
14 through a significant number of joined pipe sections,
15 whilst in other cases it is desirable to join individual
16 sections of lined pipe. Whichever method is employed,
17 the liner must be terminated at some point, and some
18 means of maintaining the continuity of the corrosion
19 barrier across the joint must be found. This is a
20 particular challenge where the method of jointing is to
21 employ heat (such as welding) as the liner may be
22 degraded during the process. As a result, the liner is
23 often terminated short of the joint so that it will be
24 unaffected by the heat generated during joining. It can
25 also be desirable to terminate the liner short of the
26 joint so as to permit the entry of tools and handling
27 aids into the ends of the pipes without causing damage to
28 the liner in the vicinity of the joint, or affecting the
29 operational effectiveness of the tools employed.

30

31 As with any such pipeline specific consideration must be
32 given to the physical engineering and installation of the
33 pipeline with actual operational conditions. It is often

1 problematic to pass a length of liner through a
2 significant number of pipe sections. Therefore it makes
3 practical sense to have a liner section associated with
4 each pipe section, the liner being connected together
5 when the pipe sections are welded.

6

7 US Patent 5,992,897 (British Gas/Tom Hill et Al., known
8 as 'Weldlink') teaches of one method of terminating a
9 liner that relies on a layer of corrosion resistant metal
10 to continue the corrosion resistance of the lined system
11 across the joint. However, this method has been found to
12 be very expensive because it relies on high-cost
13 corrosion resistant metallic components and time-
14 consuming work methods.

15

16 US Patent 3,508,766 (AMF Tuboscope/Kessler et Al.)
17 teaches of a cylindrical corrosion barrier that contains
18 a heat resistant material that allows welding to be used
19 to join sections of pipe lined with materials that would
20 otherwise be degraded on exposure to high temperatures.
21 To minimise the impact on the bore of the pipe caused by
22 the insertion of the cylindrical barrier, this patent
23 envisages the pipes being formed with belled ends. The
24 cost of providing the belled ends has been found to be
25 prohibitive.

26

27 US Patent 4,913,465 (Tuboscope/Abbema et Al., known as
28 'Thru-kote') also teaches of a cylindrical corrosion
29 barrier for connecting lined pipe sections where welding
30 is to be performed, but in this patent, the cylindrical
31 barrier is entirely within the bore of the host pipe.
32 This method is also unsatisfactory to high-pressure
33 applications because the cylindrical corrosion barriers

1 contain voids of air and other compressible material
2 between the face exposed to pressure and the wall of the
3 host pipe. The leak-tight seals at either side of the
4 joint cause a differential pressure between these voids
5 and the bore of the pipe giving rise to considerable
6 expansion forces which cause it to deform uncontrollably,
7 causing damage and distortion. Increasing the thickness
8 of the cylinder may resist this, but for high pressure
9 applications, this imposes an unacceptable restriction on
10 the bore of the pipe.

11

12 A further unsuitable aspect of sealed methods of bridging
13 the joint in a liner occurs where gases may permeate or
14 otherwise accumulate into the sealed spaces and voids
15 between the cylindrical insert and the host pipe. In
16 such circumstances when the pipeline pressure is reduced,
17 collapse may result in the same way as described in the
18 authors own PCT Application WO 02/33298 for the liner
19 itself.

20

21 It is an object of at least one aspect of the present
22 invention to provide a pipe connector suitable for
23 connecting sections of lined pipe that overcome the
24 problematic features of the sealed pipe connectors
25 described in the prior art.

26

27 According to a first aspect of the present invention
28 there is provided a pipe liner connector suitable for use
29 with pipe sections having an internal liner, the pipe
30 liner connector comprising a substantially cylindrical
31 sleeve having opposed open ends for sealed attachment to
32 the internal liner of a pipe section, and one or more
33 vents for balancing a pressure differential between a

1 micro-annulus, formed between the internal liner and the
2 pipe sections, and a bore defined by the connected pipe
3 sections.

4

5 Optionally the pipe liner connector further comprises a
6 shielding ring located between the opposed open ends.

7

8 Most preferably the shielding ring is heat resistant so
9 as to protect the pipe liner connector from welding or a
10 similar heat inducing processes.

11

12 Optionally an open end comprises a diametrically
13 increased ring section longitudinally displaced from the
14 opening towards the opposed open end, said ring section
15 having one or more venting grooves located on the outer
16 surface thereof and extending longitudinally thereon.

17

18 Preferably the open end further comprises one or more
19 seals located between the opening and the ring section
20 and having a diameter intermediate of the cylindrical
21 sleeve and the ring section.

22

23 Most preferably the one or more seals provide a liquid
24 tight connection with the internal surface of the liner
25 while the raised ring engages with the internal surface
26 of the pipe section.

27

28 Alternatively an open end comprises one or more
29 circumferential grooves suitable for receiving an
30 adhesive and a second vent located between the one or
31 more circumferential grooves and the opening.

32

33

1 According to a second aspect of the present invention
2 there is provided a pipe liner connector for use with a
3 pipe having an internal liner, the pipe liner connector
4 comprising a substantially cylindrical sleeve having
5 opposed first and second open ends, wherein the first
6 open end comprises a first diametrically increased ring
7 section longitudinally displaced from the opening towards
8 the second open end, said ring section having one or more
9 venting grooves located on the outer surface thereof and
10 extending longitudinally thereon.

11

12 Preferably the first open end further comprises one or
13 more seals located between the first opening and the
14 first ring section and having a diameter intermediate of
15 the cylindrical sleeve and the first ring section.

16

17 Optionally a second diametrically increased ring section,
18 substantially similar to the first ring section, is
19 provided adjacent to the second open end of the
20 cylindrical sleeve.

21

22 Preferably the pipe liner connector further comprises a
23 shielding ring located between the first and second ring
24 sections.

25

26 Example embodiments of the present invention will now be
27 described with reference to the following figures:

28

29 Figure 1 presents a cross section of a pipe liner
30 connector, in situ with two pipe sections, in
31 accordance with an aspect of the present invention;
32 and

33

1 Figure 2 presents a schematic representation of an
2 adhesive securing end employed in an alternative
3 embodiment of the pipe liner connector.

4
5 Referring to Figure 1 a cross section of a pipe liner
6 connector 1 is presented in conjunction with two pipe
7 sections 2. Each pipe section 2 comprises a vented liner
8 3 that terminates with a cylindrical recess 4, of a
9 greater internal diameter than that of the vented liner 3
10 itself. The cylindrical recesses 4 provide a means for
11 locating the pipe liner connector 1 between two pipe
12 sections 2, thereafter being fixed in position by the
13 employment of locking rings 5.

14
15 The locking ring 5 is sized such that when it is inserted
16 it squeezes the liner 3 tightly to the internal surface
17 of the pipe section 2, holding it in place by a spring
18 action and an associated compression in the liner 3.
19 Alternatively, the locking ring comprises fixing screws
20 (not shown) that adjust outwardly to compress the liner 3
21 to the internal surface of the pipe section 2.

22
23 The pipe liner connector 1 comprises a sleeve 6 that is
24 generally in the form of a cylindrical tube having
25 opposed open ends 7 and 8. The outer surface of the
26 sleeve 6 has a diameter that is slightly less than the
27 minimum inner diameter tolerance of the cylindrical
28 recesses 4 therefore allowing adjacent ends 7 and 8 of
29 the pipe liner connector 1 to be inserted into the vented
30 liners 3.

31
32 Starting at either end 7 or 8 of the pipe liner
33 connector 1, and working towards the centre, the outer

1 surface of the sleeve 6 can be seen to comprise a number
2 of elements. Initially there is found a groove 9
3 suitable for locating a sealing ring 10.

4
5 The second element is a raised ring section 11. The
6 raised ring section 11 has an outer diameter that is
7 slightly less than the minimum inner diameter tolerance
8 of the pipe section 2 but has a diameter greater than the
9 maximum inner diameter of the cylindrical recess 4.
10 Therefore, when the pipe liner connector 1 is inserted
11 into the pipe section 2 the raised ring section 11 abuts
12 against the end of the vented liner 3 so preventing the
13 pipe liner connector 1 from accidentally passing into the
14 pipe section 2.

15
16 In order to equalise the pressure within the micro-
17 annulus between the pipe section 2 and the area of the
18 pipe liner connector 1 between the sealing rings 10 a
19 number of venting grooves 12 are formed longitudinally
20 across the outer surface of the raised ring section 11.
21 In this particular embodiment the venting grooves 12 have
22 a rectangular cross section however a triangular,
23 circular or other suitably shaped cross section may
24 readily be employed.

25
26 The third element is a vent 13 located within the body of
27 the sleeve. The vent 13 provides a means for
28 communicating pressure from micro-annulus between the
29 pipe section 2 and the pipe liner connector 1 and the
30 pipe section bore. The vent 13 is made from an
31 engineering grade plastic and contains a "frit" or a
32 porous membrane that controls the flow of gas through the
33 vent 13. Since any by-products in the micro annulus are

1 free to continue across the length of the pipe liner
2 connector 1 and onto the vents 13, the risk of liner
3 collapse around the pipe liner connector 1 is
4 significantly reduced.

5
6 The final element of the pipe liner connector 1 is a
7 central shielding portion 14. The central shielding
8 portion 14 comprises a shielding ring 15. When the pipe
9 liner connector 1 is located with two pipe sections 2 the
10 shielding ring 15 locates directly below the interface of
11 the pipe sections 2. With the shielding ring 15 so
12 located the pipe sections 2 may be welded together
13 without the substantial heat generated by the welding
14 process damaging either the pipe liner connector 1 or the
15 vented liner 3.

16
17 It will be evident to one skilled in the art that the
18 incorporation of the central shielding portion 14 and the
19 shielding ring 15 can be omitted when there is no welding
20 required to be carried out between two adjacent pipe
21 sections 2. For example this would be the case if the
22 pipe sections 2 were to be joined by screwing the
23 sections together or by flanging.

24
25 In an alternative embodiment the pipe liner connector 1
26 comprises adhesive securing ends 16 as presented in
27 Figure 2. The adhesive securing ends 16 can be seen to
28 comprise a tapered open end 17, a second vent 18, three
29 circumferential grooves 19 suitable for retaining an
30 adhesive and a sealing ring 10. The adhesive securing
31 ends 16 provide the required sealing for the pipe liner
32 connector 1 while the second vents 18 prevent a build up

1 of pressure within the volume of the micro annulus
2 immediately above the second vent 18.

3

4 In a further embodiment (not shown) the adhesive ends
5 further comprises a locking ring. Alternatively, the
6 securing of the liner 3 may take place at some central
7 point so that the cylindrical recess 4 areas are free to
8 expand or contract across the overlapping section with
9 the pipe line connector 1.

10

11 A significant advantage of aspects of the present
12 invention is that they provide a means of connecting
13 sections of lined pipe that prevents corrosion by
14 prohibiting any corrosive agents coming into contact with
15 the pipe wall. In addition the inclusion of the venting
16 grooves and the vents helps to preventing the collapse or
17 the uncontrolled distortion of the pipe liner connector
18 during pressure cycles in operating pipelines by allowing
19 a controlled pressure balance between the pipe liner
20 connector and the pipe bore.

21

22 A further advantage of the pipe liner connector described
23 in the present invention is that it provides a means for
24 allowing pipe sections comprising associated liners to be
25 welded together without the welding process damaging
26 either the pipe liner connector or the liner. Therefore,
27 by employing the pipe liner connector the construction of
28 pipelines for use in oil and gas production or within the
29 associated refining and transportation industries can be
30 made both more efficient and more cost effective.

31

32 The foregoing description of the invention has been
33 presented for purposes of illustration and description

1 and is not intended to be exhaustive or to limit the
2 invention to the precise form disclosed. The described
3 embodiments were chosen and described in order to best
4 explain the principles of the invention and its practical
5 application to thereby enable others skilled in the art
6 to best utilise the invention in various embodiments and
7 with various modifications as are suited to the
8 particular use contemplated. Therefore, further
9 modifications or improvements may be incorporated without
10 departing from the scope of the invention herein
11 intended.

1 **Claims**

2

3 1) A pipe liner connector suitable for use with pipe
4 sections having an internal liner, the pipe liner
5 connector comprising a substantially cylindrical
6 sleeve having opposed open ends for sealed attachment
7 to the internal liner of a pipe section, and one or
8 more vents for balancing a pressure differential
9 between a micro-annulus, formed between the internal
10 liner and the pipe sections, and a bore defined by
11 the connected pipe sections.

12

13 2) A pipe liner connector as claimed in Claim 1 wherein
14 the pipe liner connector further comprises a
15 shielding ring located between the opposed open ends.

16

17 3) A pipe liner connector as claimed in Claim 2 wherein
18 the shielding ring is heat resistant so as to protect
19 the pipe liner connector from welding or a similar
20 heat inducing processes.

21

22 4) A pipe liner connector as claimed in any of the
23 preceding Claims wherein an open end comprises a
24 diametrically increased ring section longitudinally
25 displaced from the opening towards the opposed open
26 end, said ring section having one or more venting
27 grooves located on the outer surface thereof and
28 extending longitudinally thereon.

29

30 5) A pipe liner connector as claimed in Claim 4 wherein
31 the open end further comprises one or more seals
32 located between the opening and the ring section and

- 1 having a diameter intermediate of the cylindrical
2 sleeve and the ring section.
3
- 4 6) A pipe liner connector as claimed in Claim 4 wherein
5 the one or more seals provide a liquid tight
6 connection with the internal surface of the liner
7 while the raised ring engages with the internal
8 surface of the pipe section.
9
- 10 7) A pipe liner connector as claimed in any of the
11 preceding claims wherein an open end comprises one or
12 more circumferential grooves suitable for receiving
13 an adhesive and a second vent located between the one
14 or more circumferential grooves and the opening.
15
- 16 8) A pipe liner connector for use with a pipe having an
17 internal liner, the pipe liner connector comprising a
18 substantially cylindrical sleeve having opposed first
19 and second open ends, wherein the first open end
20 comprises a first diametrically increased ring
21 section longitudinally displaced from the opening
22 towards the second open end, said ring section having
23 one or more venting grooves located on the outer
24 surface thereof and extending longitudinally thereon.
25
- 26 9) A pipe liner as claimed in Claim 8 wherein the first
27 open end further comprises one or more seals located
28 between the first opening and the first ring section
29 and having a diameter intermediate of the cylindrical
30 sleeve and the first ring section.
31
- 32 10) A pipe liner as claimed in Claim 8 or Claim 9 wherein
33 the second open end further comprises a second

1 diametrically increased ring section longitudinally
2 displaced from the opening towards the first open
3 end, said ring section having one or more venting
4 grooves located on the outer surface thereof and
5 extending longitudinally thereon.
6

7 11) A pipe liner as claimed in Claim 10 wherein the
8 second open end further comprises one or more seals
9 located between the second opening and the second
10 ring section and having a diameter intermediate of
11 the cylindrical sleeve and the first ring section.
12

13 12) A pipe liner as claimed in Claim 8 to Claim 11
14 wherein the pipe liner connector further comprises a
15 shielding ring located between the first and second
16 ring sections.

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SUBSTITUTE SHEET (RULE 26)

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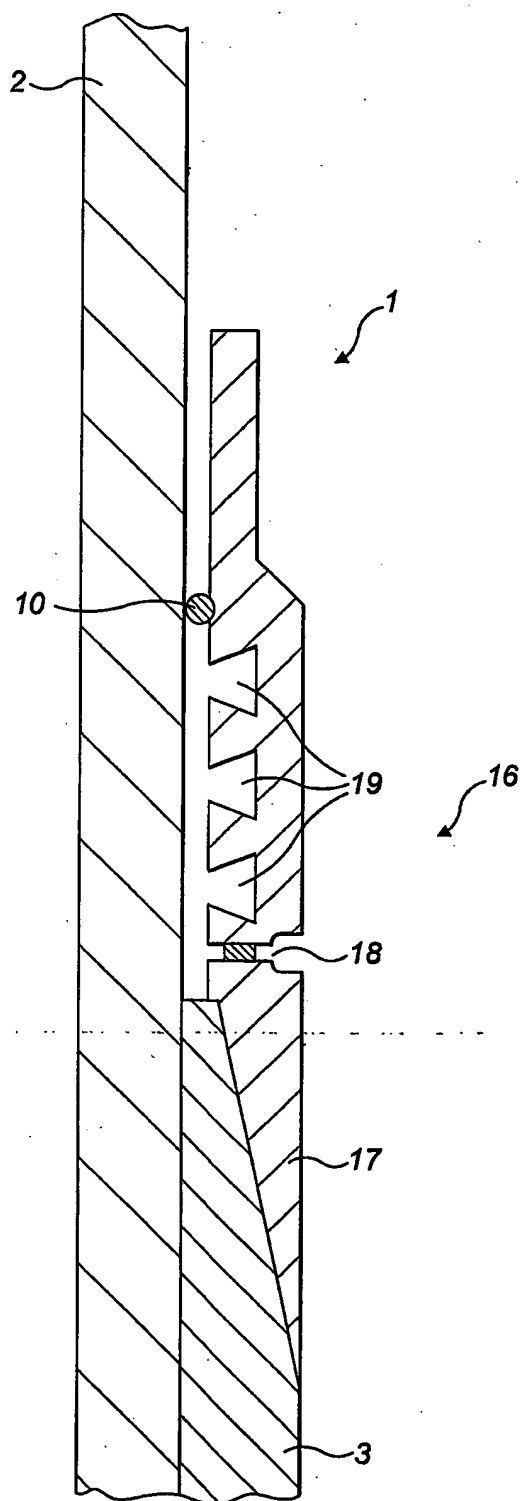


FIG. 2

INTERNATIONAL SEARCH REPORT

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A. CLASSIFICATION OF SUBJECT MATTER
IPC 7 F16L13/02 F16L55/165

According to International Patent Classification (IPC) or to both national classification and IPC

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)
IPC 7 F16L

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

Electronic data base consulted during the International search (name of data base and, where practical, search terms used)

WPI Data, EPO-Internal, PAJ

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category *	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
Y	US 5 566 984 A (ABBEMA WILLIAM D ET AL) 22 October 1996 (1996-10-22)	1-6,8-12
A	column 1, line 9 - line 51 column 5, line 25 - column 11, line 15; figures 3,5-7	7
Y	WO 02 33298 A (MCINTYRE STUART ;BOREAS CONSULTANTS LTD (GB)) 25 April 2002 (2002-04-25) cited in the application page 1, line 3 - page 4, line 11; figure 1	1-3
Y	US 4 681 349 A (KRIEG JOHN ET AL) 21 July 1987 (1987-07-21)	4-6,8-12
A	column 2, line 18 - line 57 column 6, line 9 - line 56 column 8, line 20 - line 32; figures 8,16-19,24,25	1,7
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☒ Further documents are listed in the continuation of box C.

☒ Patent family members are listed in annex.

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Date of the actual completion of the international search

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European Patent Office, P.B. 5818 Patentlaan 2
NL - 2280 HV Rijswijk
Tel (+31-70) 340-2040, Tx. 31 651 epo nl,
Fax (+31-70) 340-3016

Authorized officer

Vecchio, G

INTERNATIONAL SEARCH REPORT

International Application No
PCT/GB 03/03272

C.(Continuation) DOCUMENTS CONSIDERED TO BE RELEVANT		
Category *	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
A	<p>US 5 988 691 A (CRUICKSHANK JOHN DUNCAN) 23 November 1999 (1999-11-23) column 4, line 53 -column 6, line 55; figures 1,3</p> <p>-----</p>	1,4-11

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